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(54) **ELEMENT SUBSTRATE, LIQUID EJECTION HEAD, AND METHOD OF MANUFACTURING ELEMENT SUBSTRATE**

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B41J 2/14 (2006.01)

(52) **U.S. Cl.**
CPC ***B41J 2/04563*** (2013.01); ***B41J 2/14129*** (2013.01); ***B41J 2/14153*** (2013.01); *B41J 2202/18* (2013.01)

(58) **Field of Classification Search**
CPC .. B41J 2/0456; B41J 2/14129; B41J 2/14153; B41J 2202/18
See application file for complete search history.

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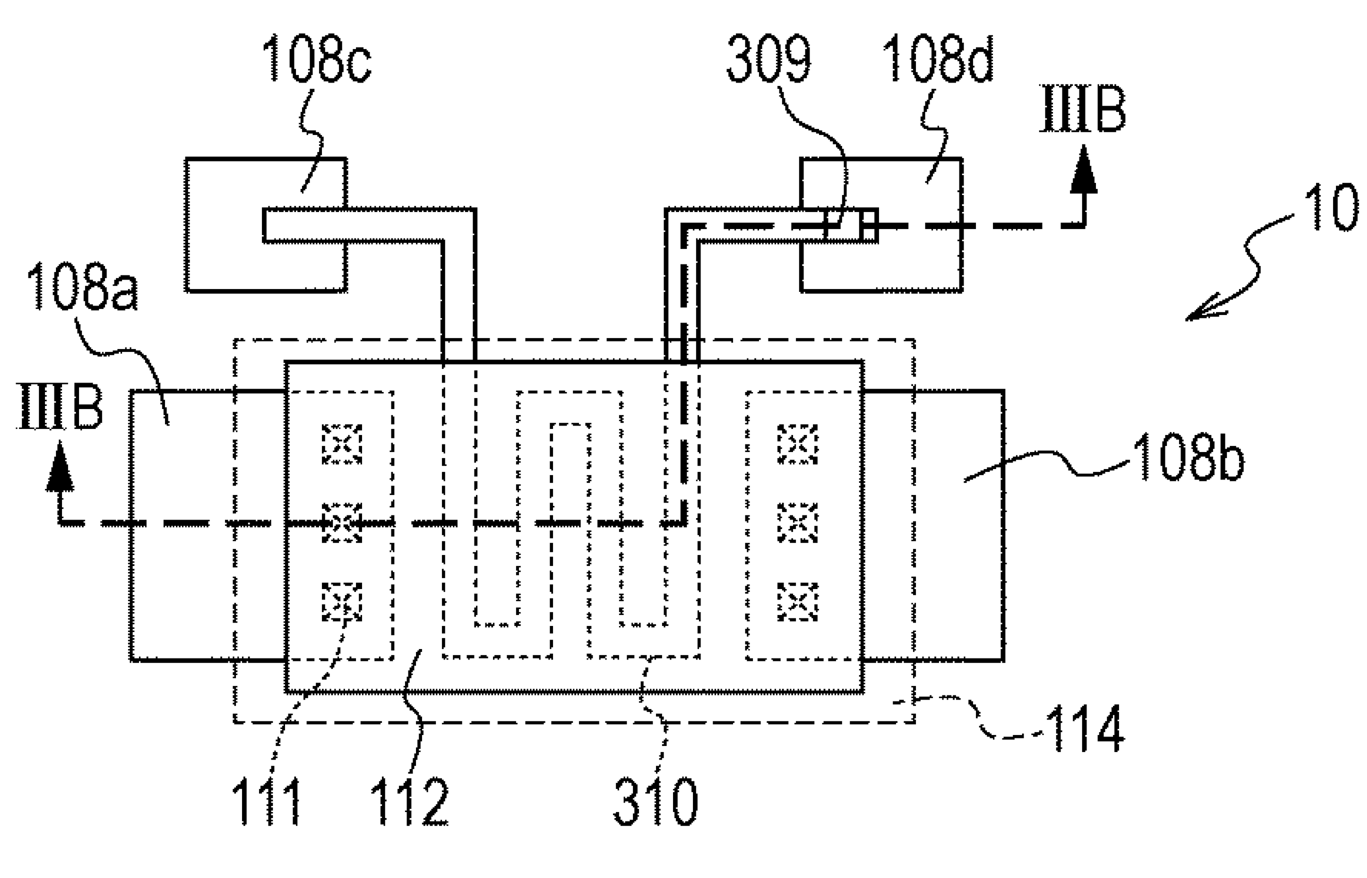
(57) **ABSTRACT**

An element substrate has a layered structure including a heating resistance element, a first insulation layer where a temperature detection element constituted by a via is formed, and a second insulation layer provided between the heating resistance element and the temperature detection element which electrically insulates the heating resistance element and the temperature detection element.

10 Claims, 6 Drawing Sheets



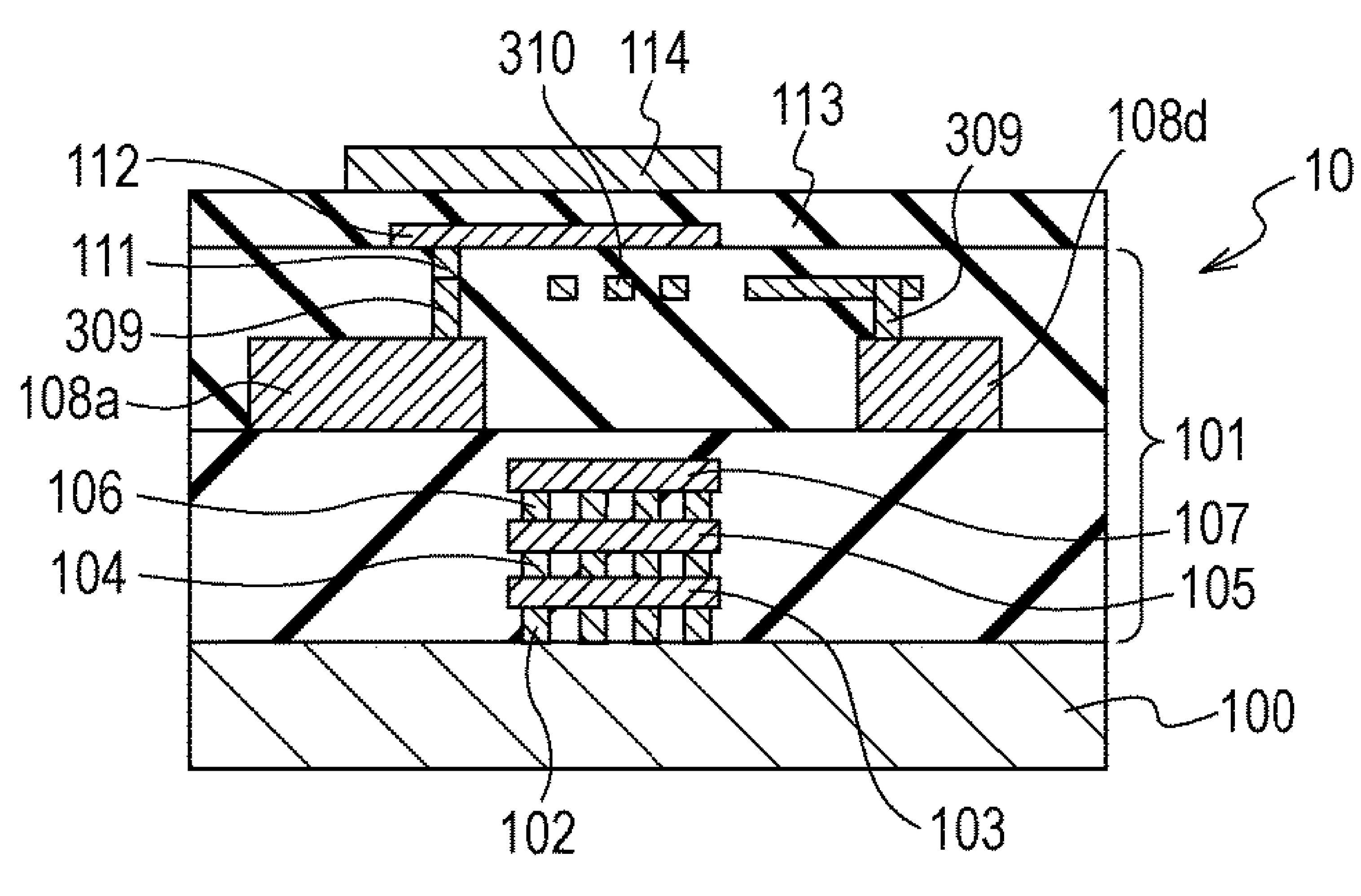


FIG. 1A

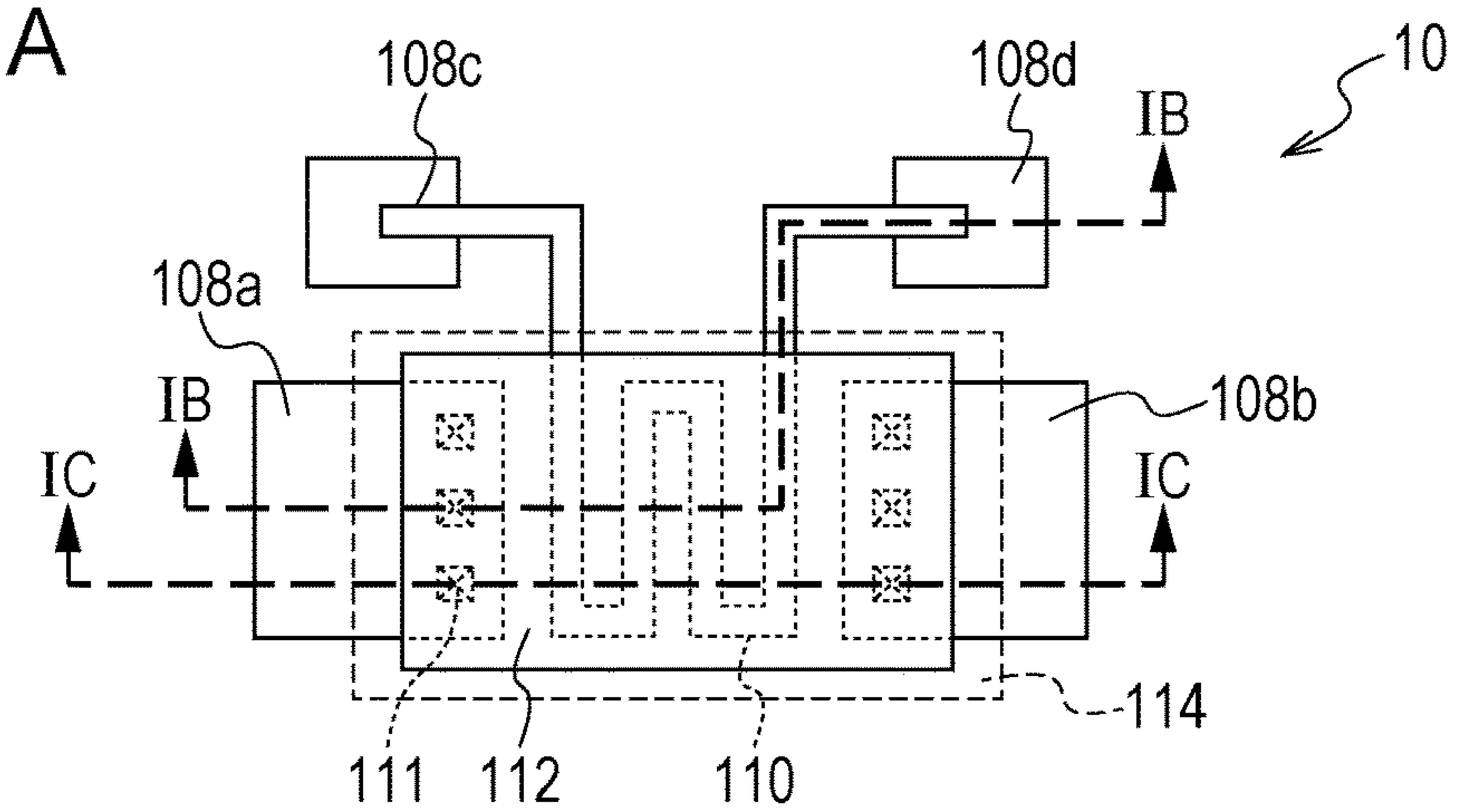


FIG. 1B

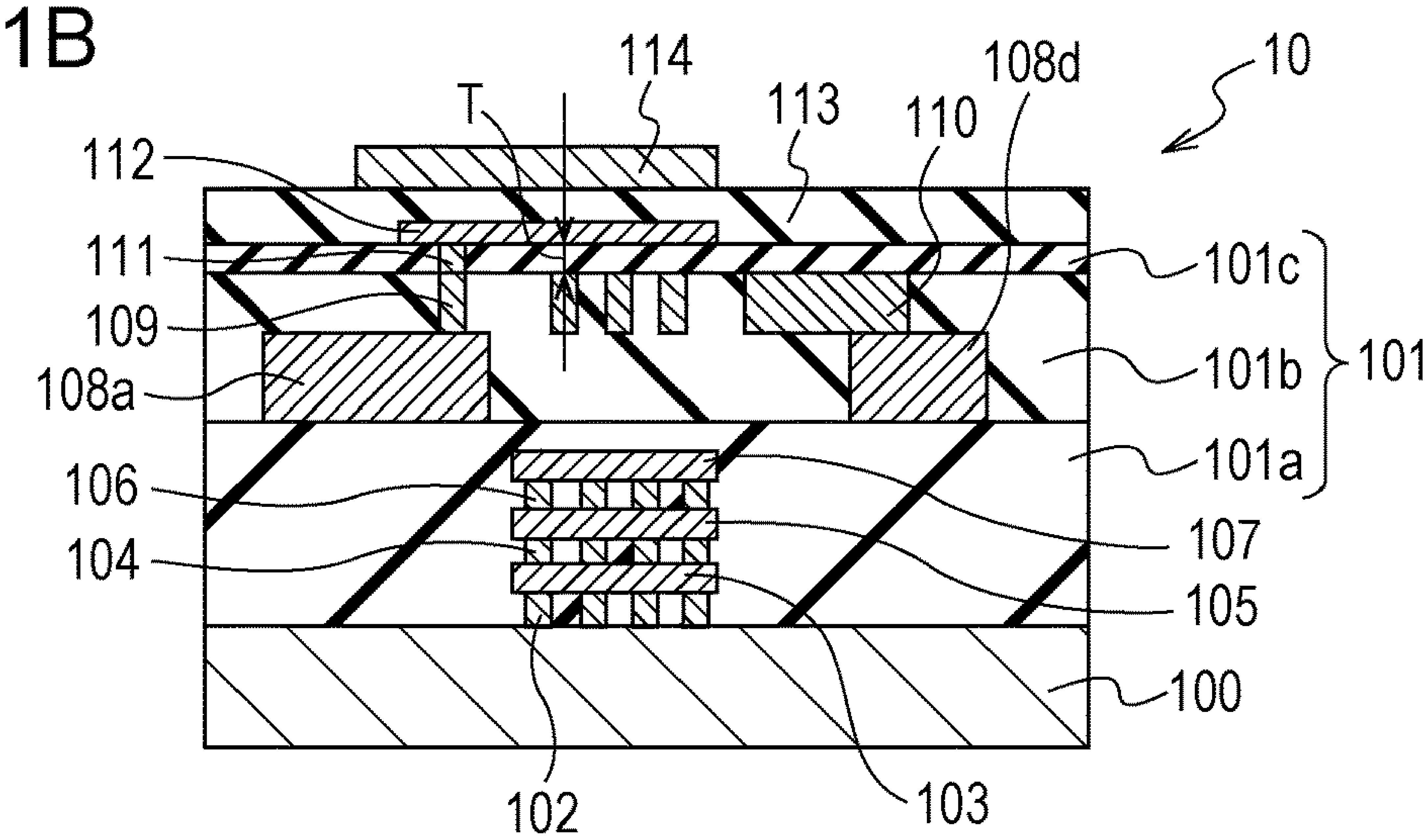


FIG. 1C

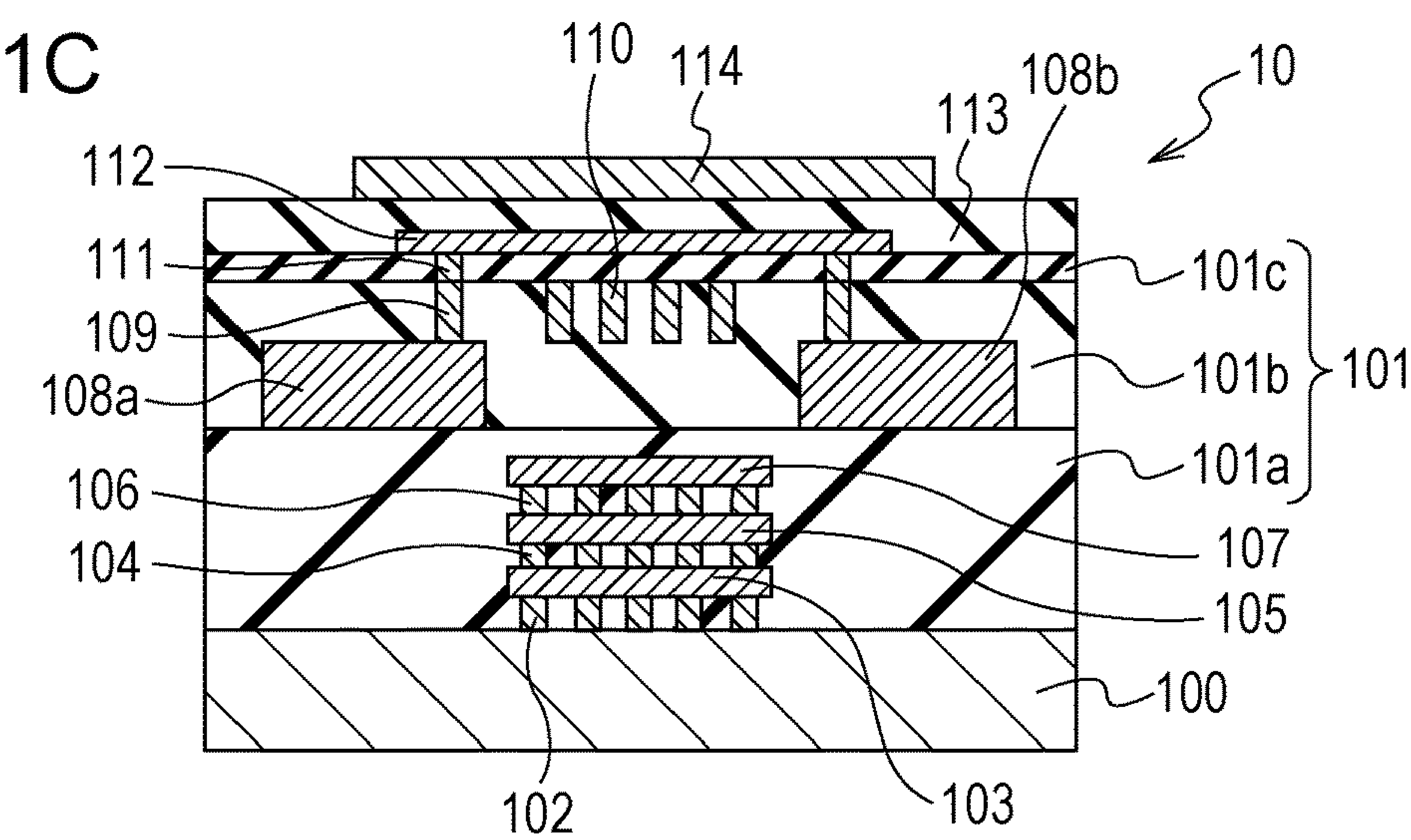


FIG. 2A

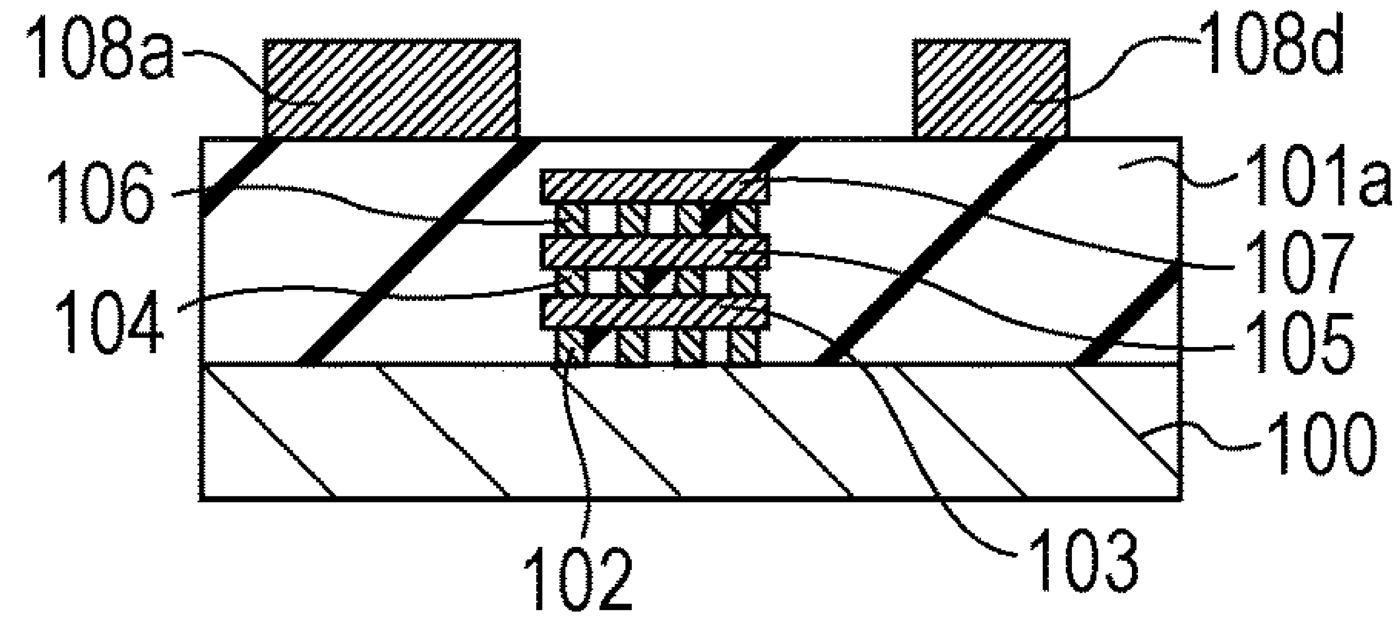


FIG. 2B

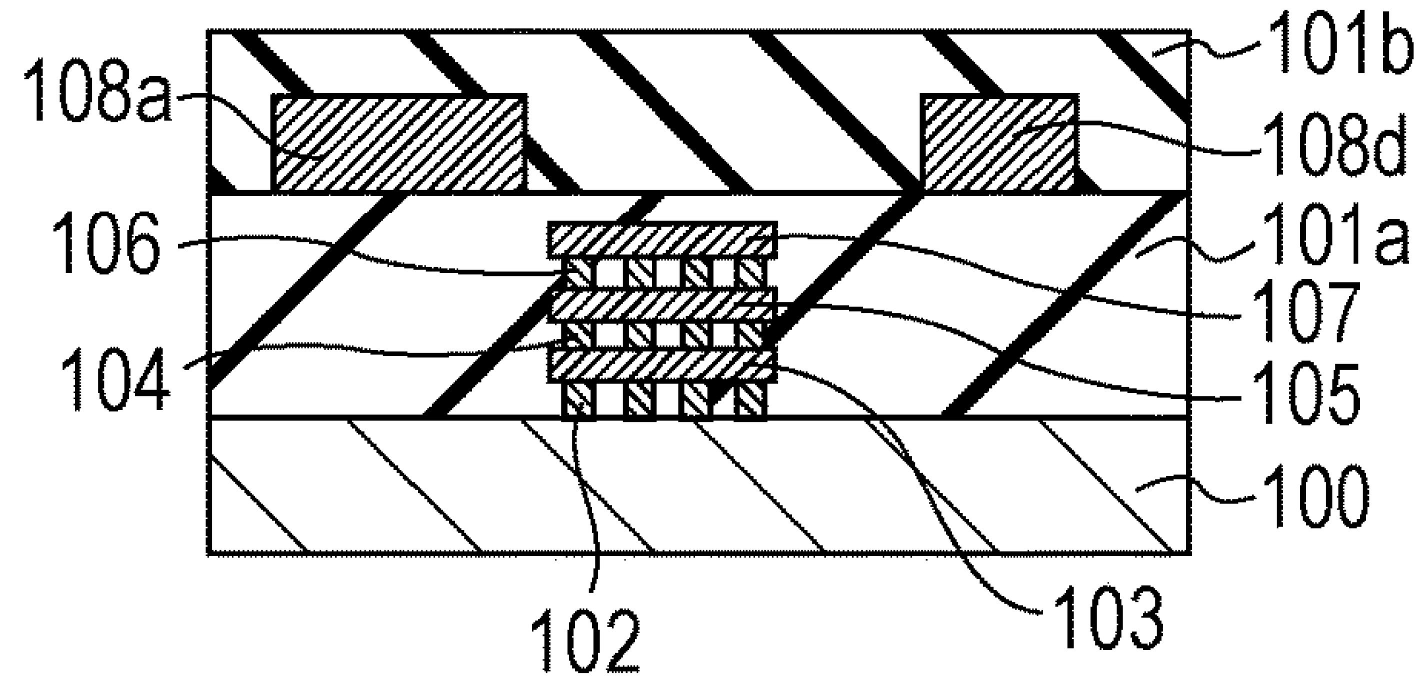


FIG. 2C

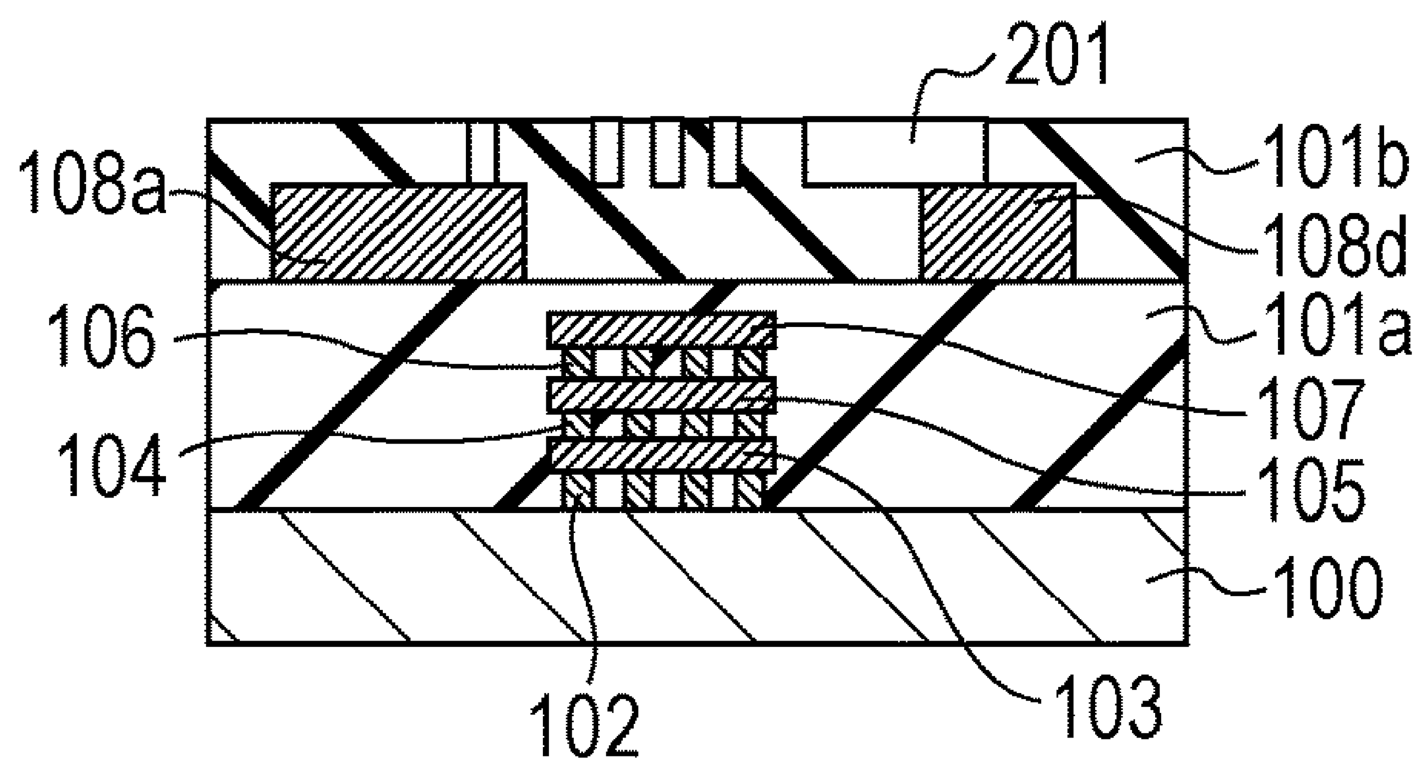


FIG. 2D

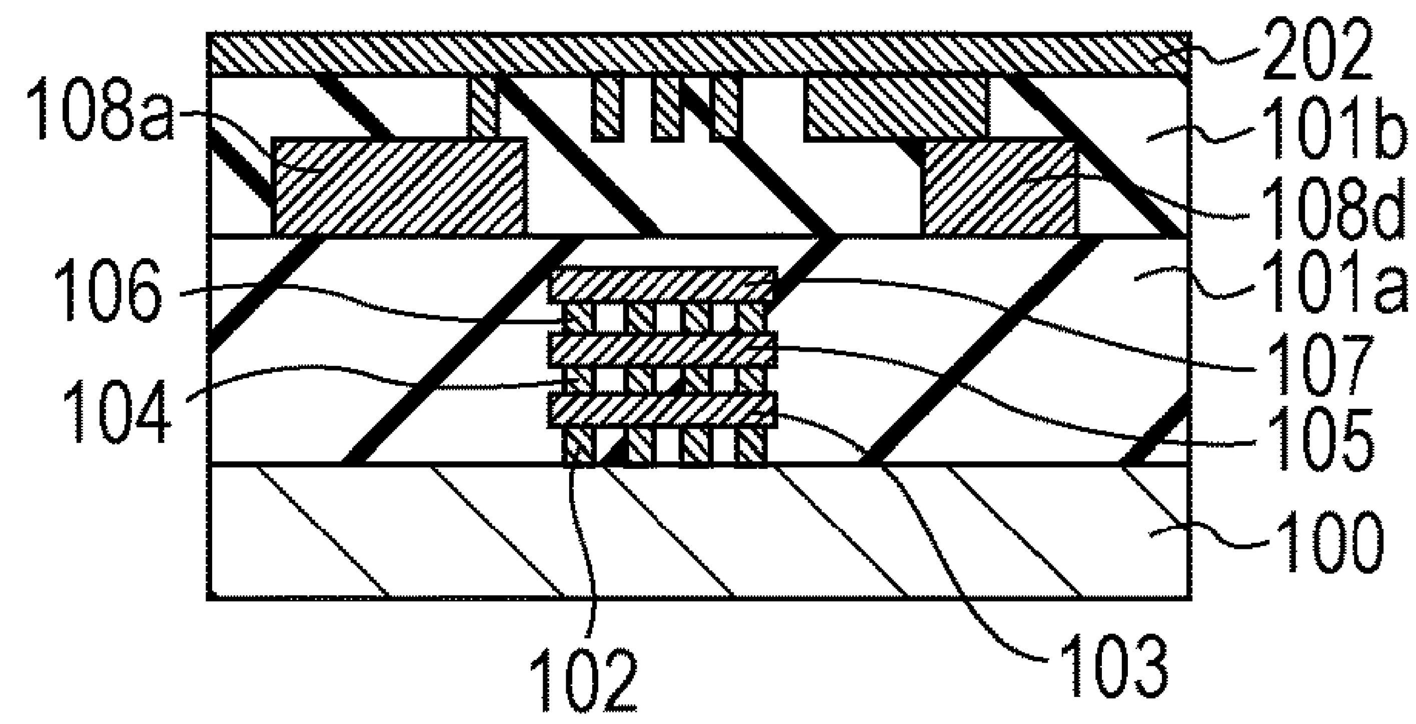


FIG. 2E

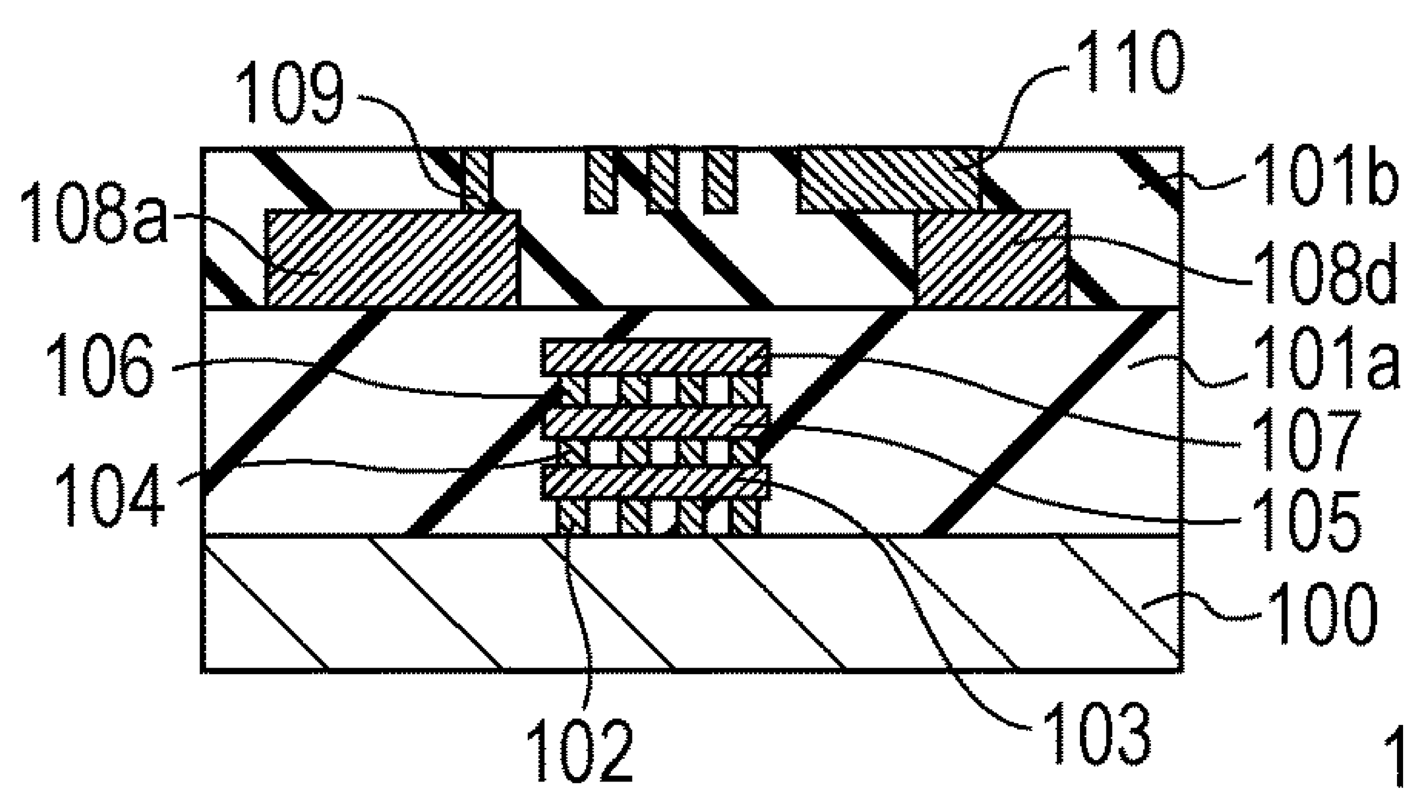


FIG. 2F

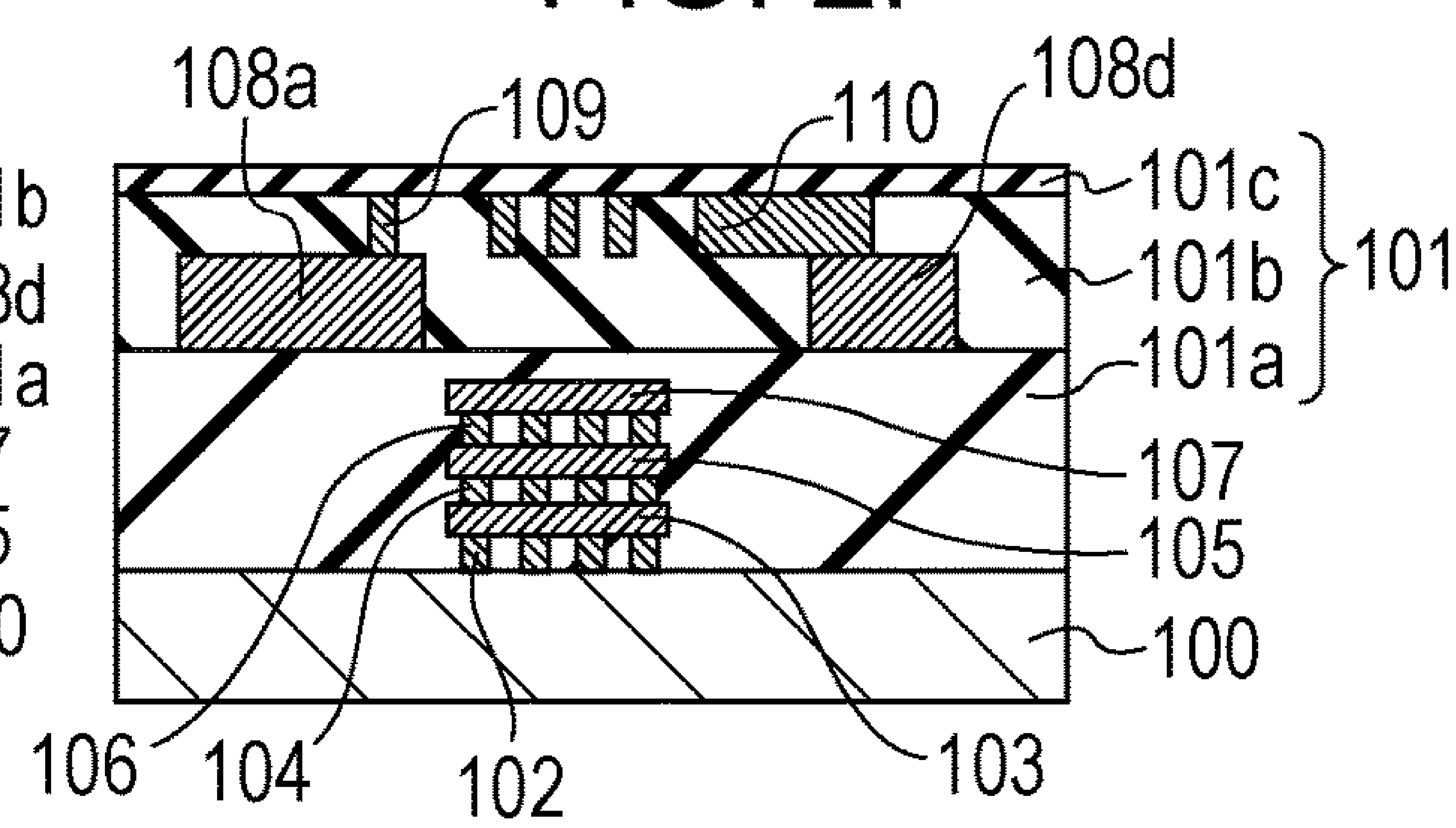


FIG. 2G

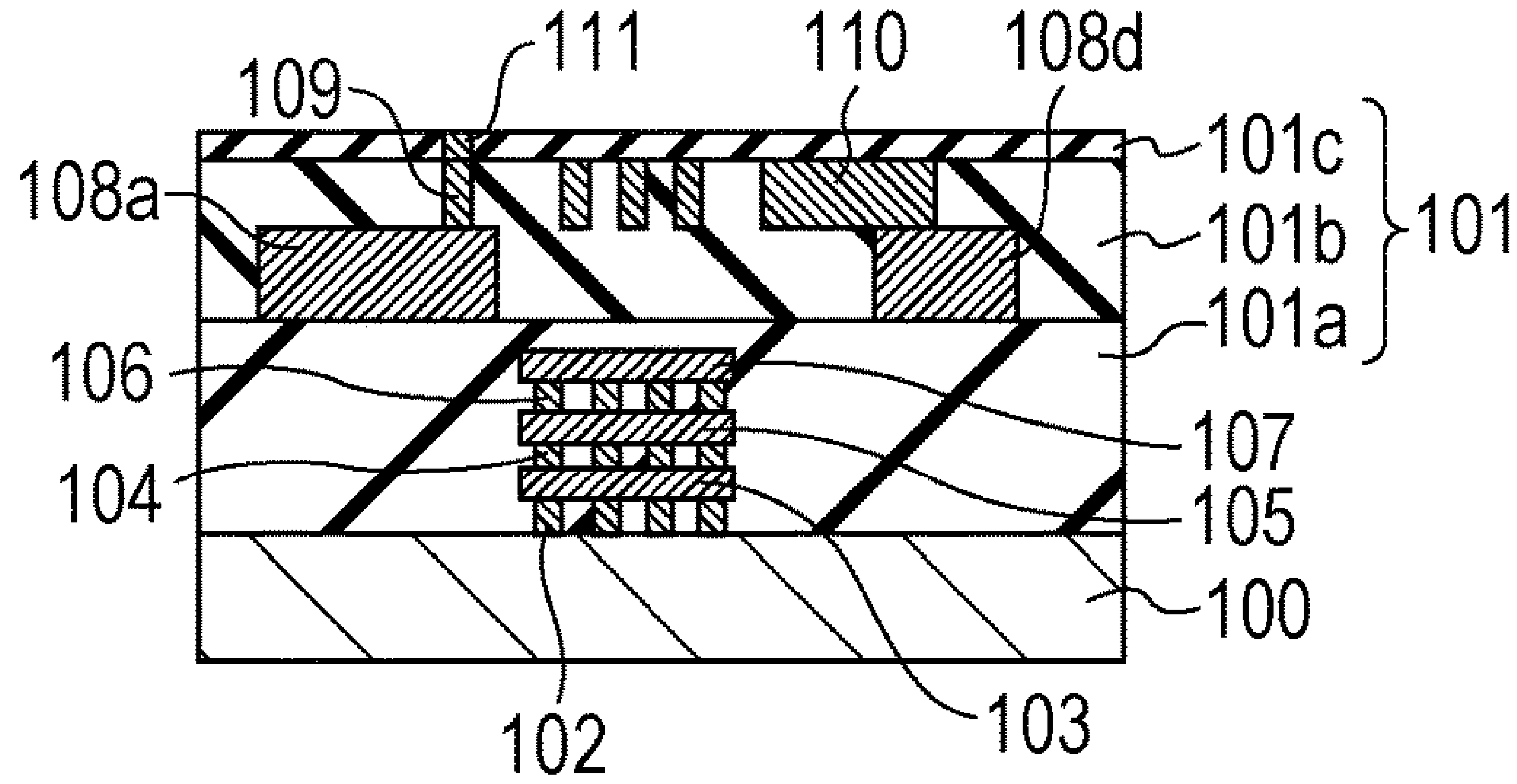


FIG. 3A

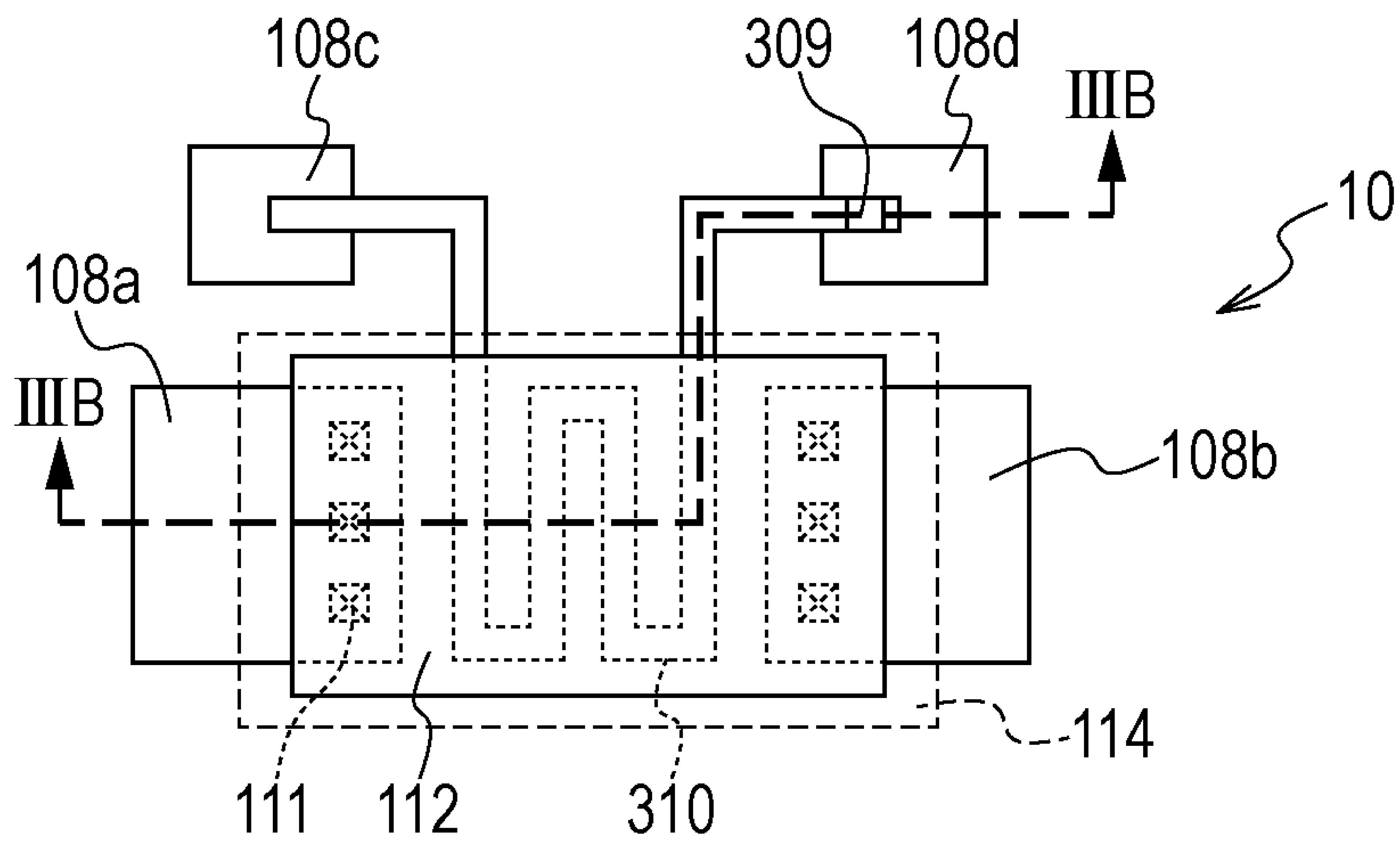

108c
309
108d
ⅢB
10
108a
ⅢB
108b
114
111
112
310

FIG. 3B

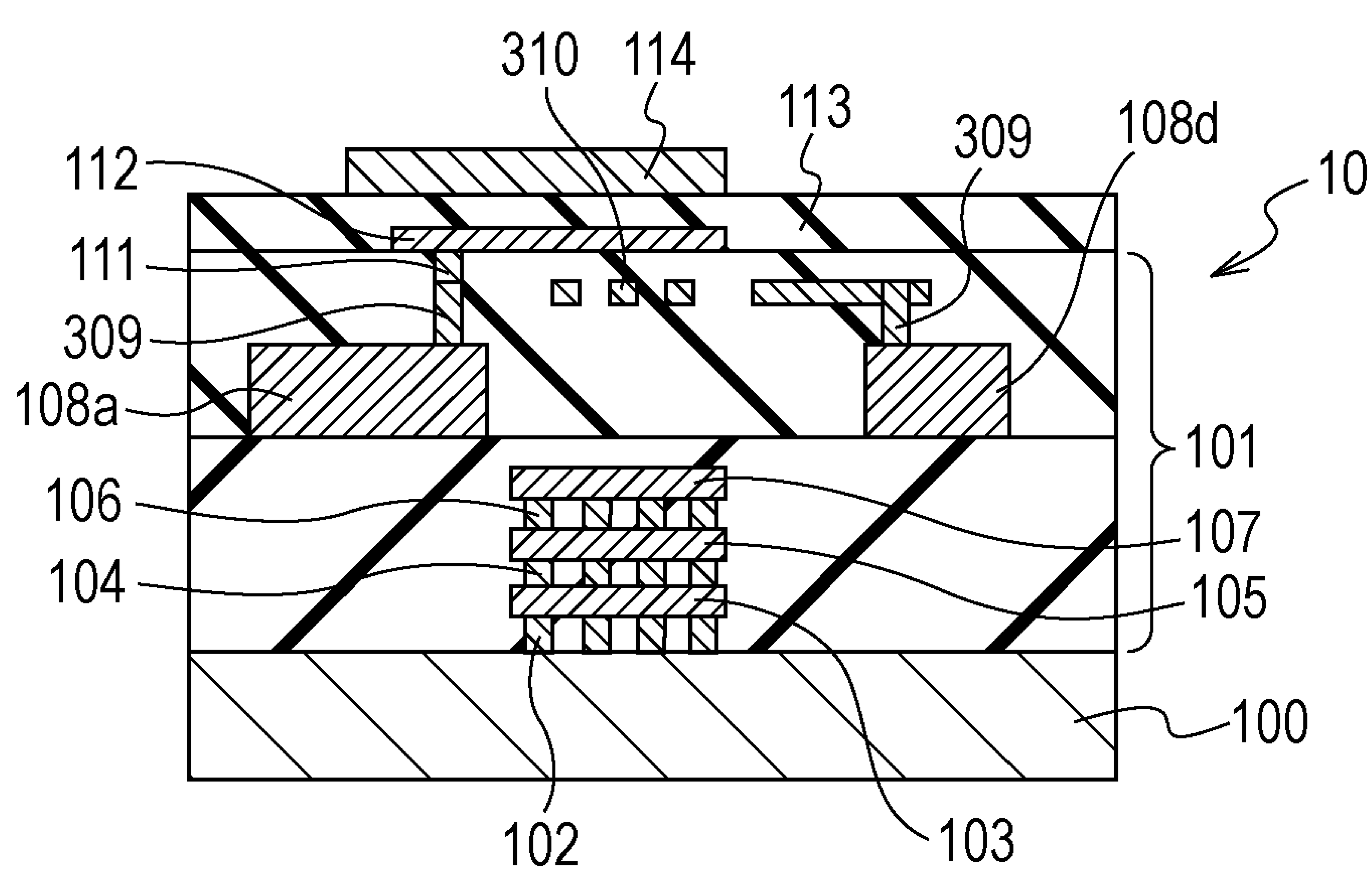

310
114
113
309
108d
112
10
111
309
108a
101
106
107
104
105
100
102
103

FIG. 4A

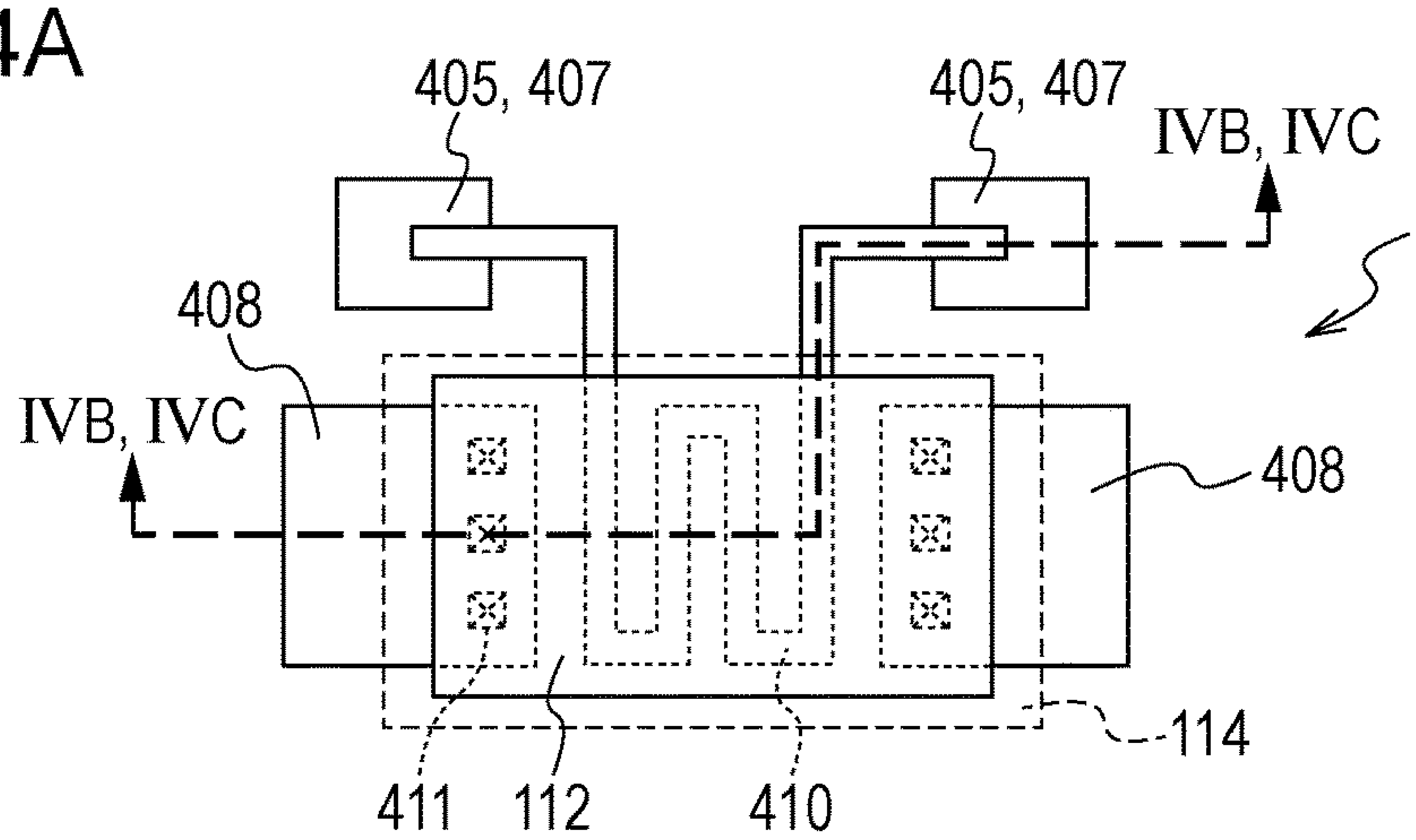


FIG. 4B

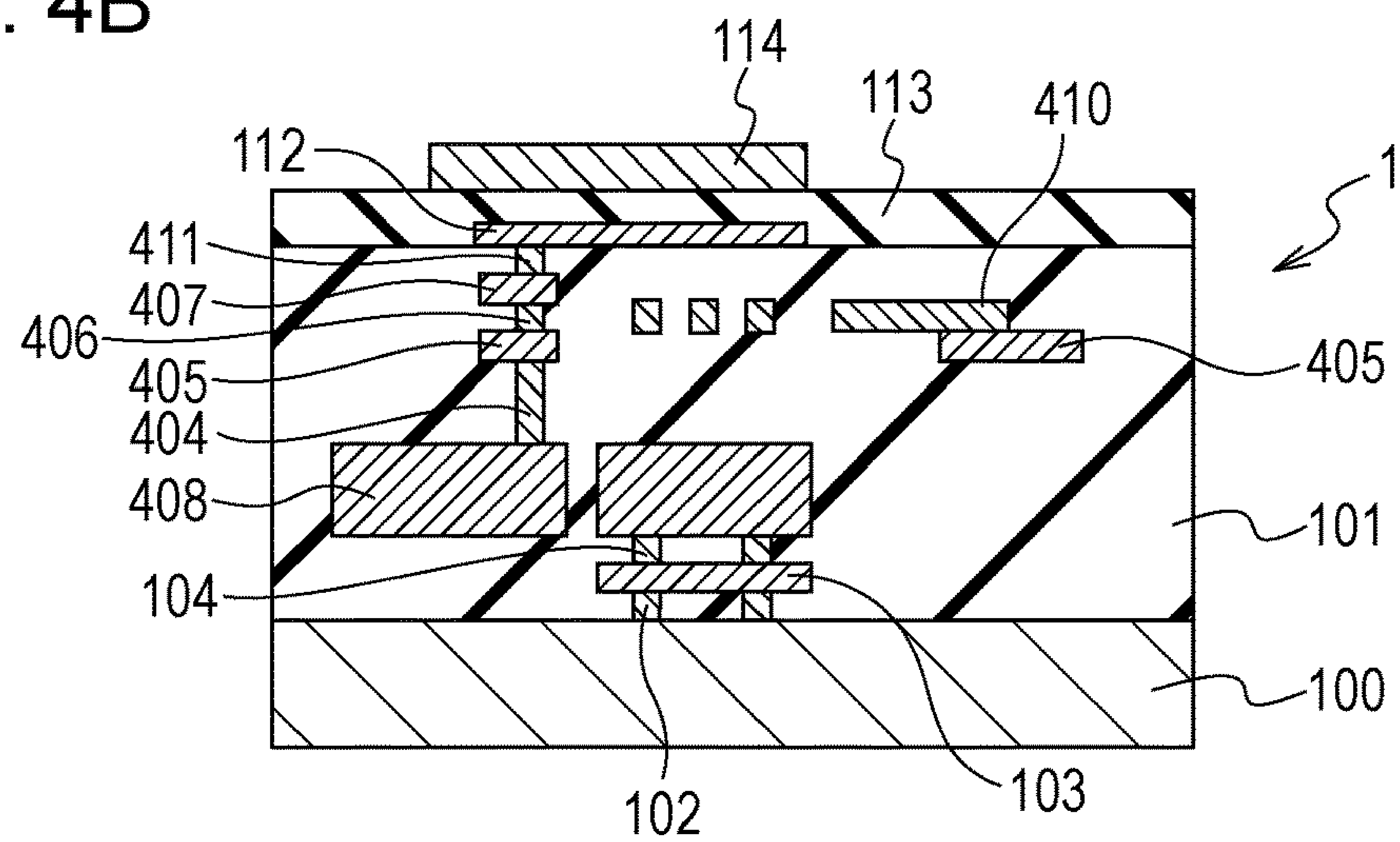


FIG. 4C

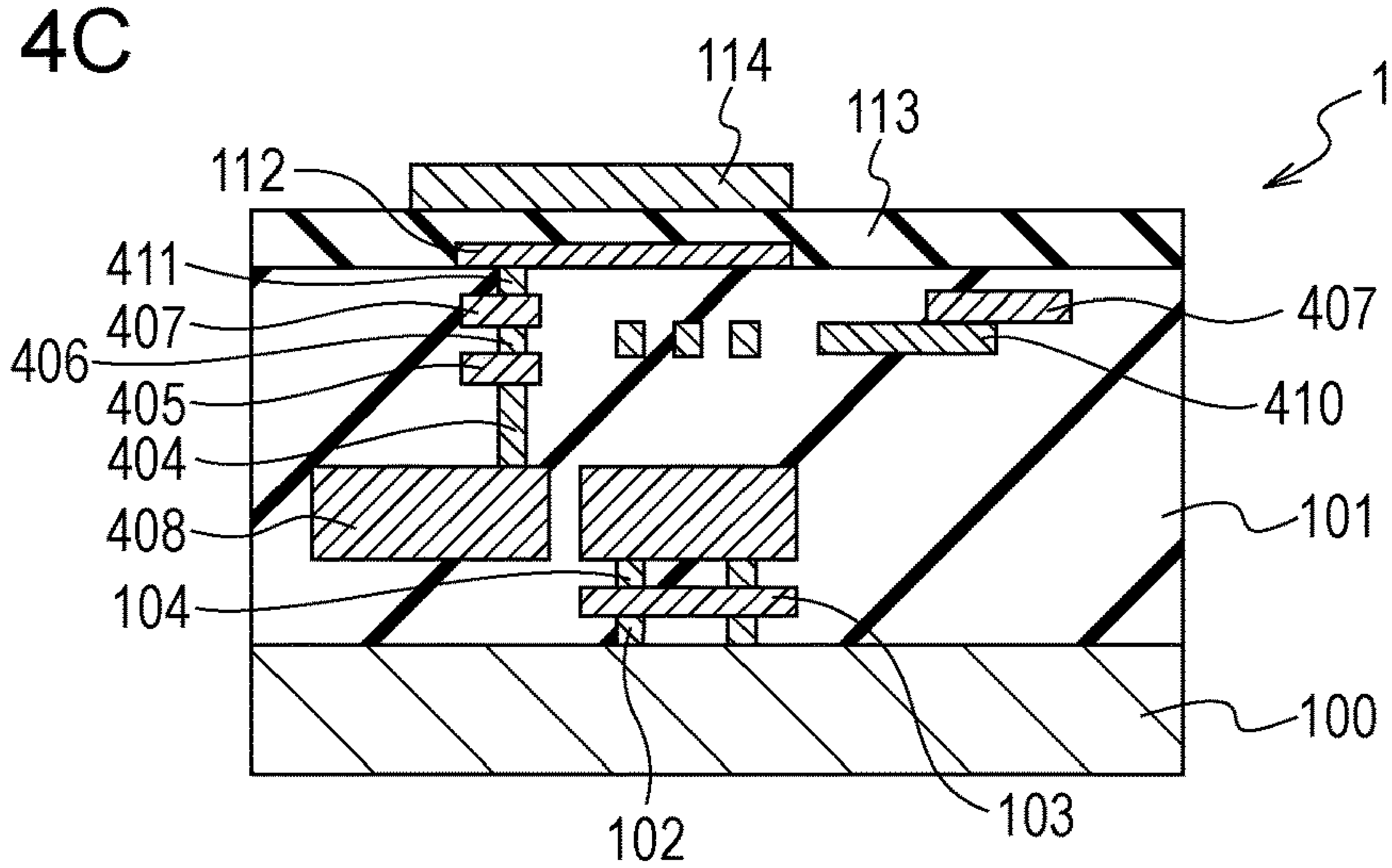


FIG. 5A

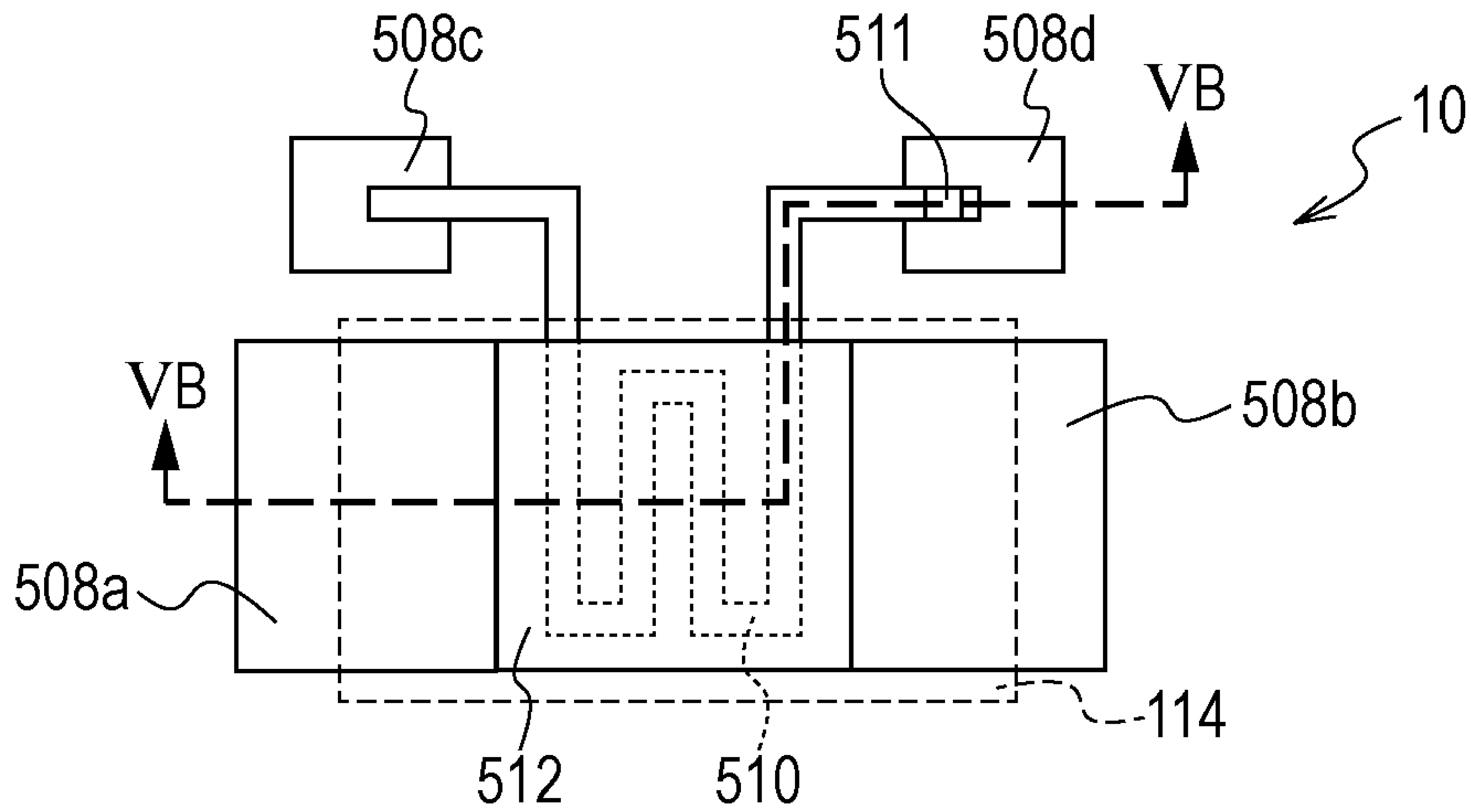

508c
511
508d
VB
10
VB
508b
508a
114
512
510

FIG. 5B

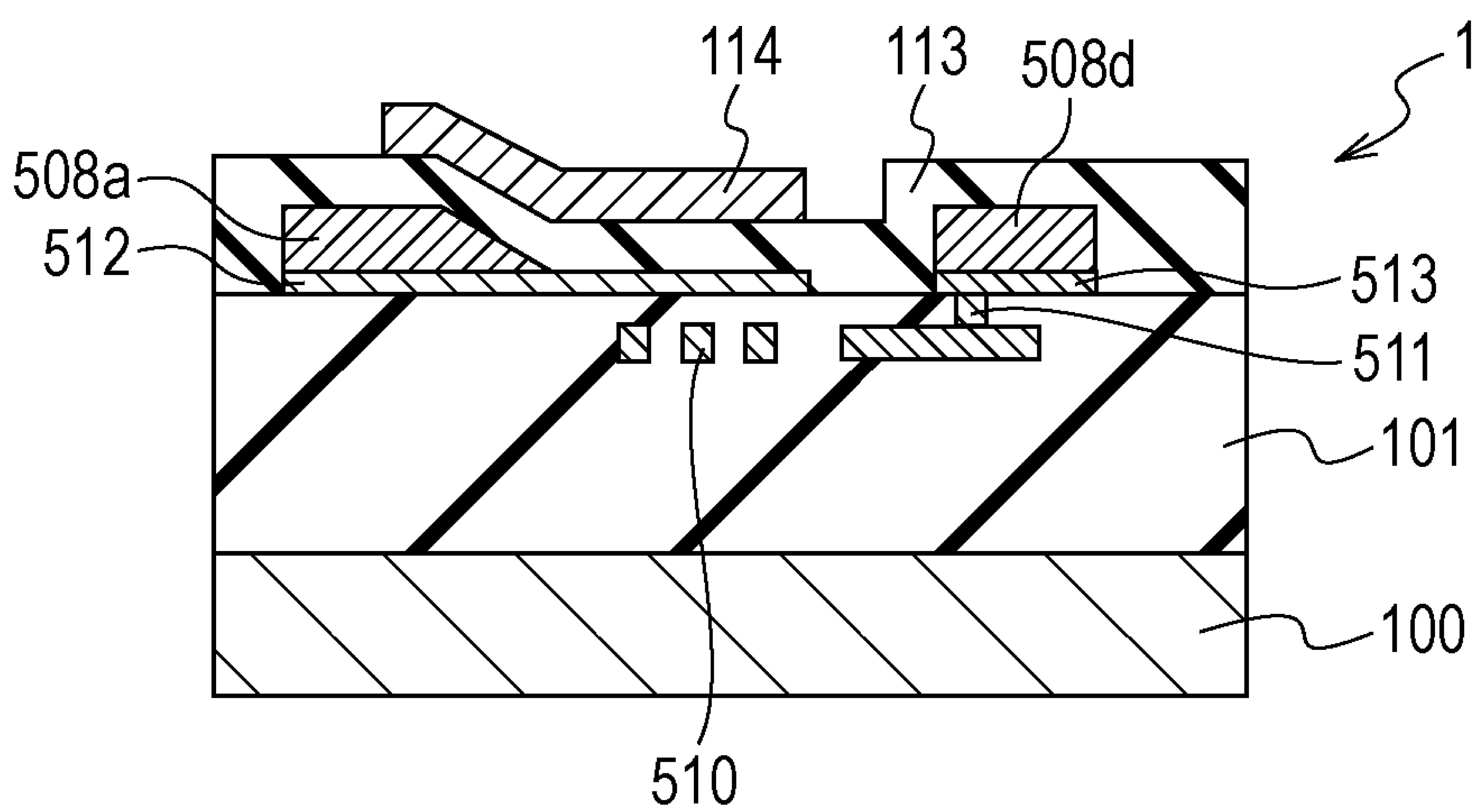
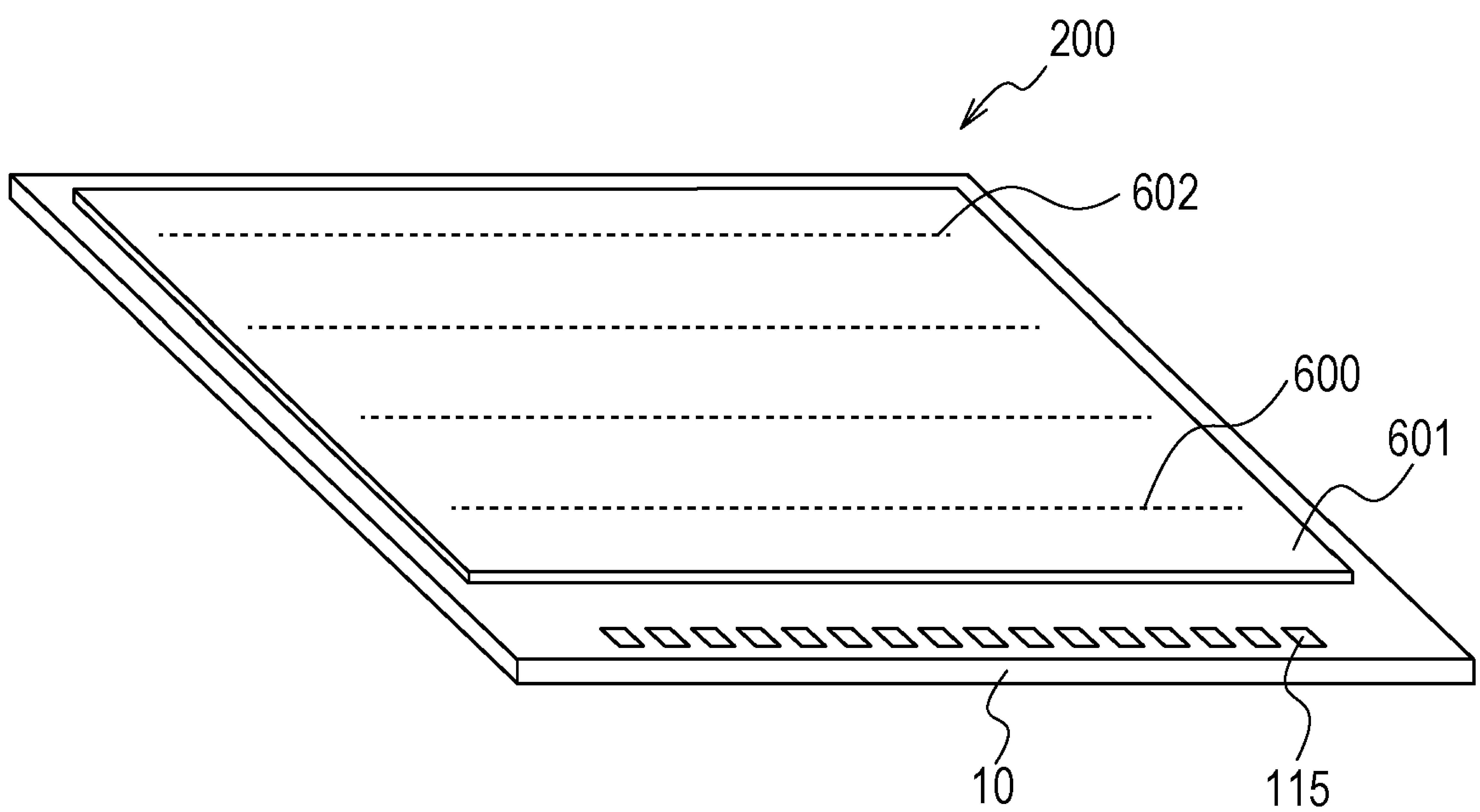

114
113
508d
10
508a
512
513
511
101
100
510

FIG. 6



ELEMENT SUBSTRATE, LIQUID EJECTION HEAD, AND METHOD OF MANUFACTURING ELEMENT SUBSTRATE

FIELD OF THE DISCLOSURE

The present disclosure generally relates to an element substrate that has a heating resistance element, a liquid ejection head that ejects liquid, and a method of manufacturing the element substrate.

DESCRIPTION OF THE RELATED ART

As liquid ejection heads used for liquid ejection printers, liquid ejection heads of a heat ejection type, a piezoelectric element type, and the like are used. A liquid ejection head of the heat ejection type ejects liquid droplets such as ink onto a recording sheet by using heat energy generated by a heating resistance element and forms an image or the like. The liquid ejection head of the heat ejection type is able to generate relatively high heat energy, even when the heating resistance element has a small area, and is thus suitable for dealing with high-density recording. The liquid ejection head has an element substrate that includes the heating resistance element.

These days, the element substrate of the liquid ejection head includes a temperature detection element (temperature sensor) that detects temperature. The temperature detection element is used to acquire information about the temperature, and the heating resistance element is controlled. Japanese Patent Laid-Open No. 2018-24126 describes a configuration including a temperature detection element formed by connecting two wires of layers to each other in series with a via therebetween.

According to the configuration as described in Japanese Patent Laid-Open No. 2018-24126, however, in a temperature detection element that detects a change in temperature on the basis of a change in electrical resistance of a constituent material, the connection resistance of the wires and the via is the dominant resistance, such that sufficient sensitivity may not be achieved. For example, the connection resistance between the wires and the via is large and about 100 to 10000 times higher than the resistance of the materials of the wires and the via, such that it is difficult to detect the change in the resistance of the temperature detection element caused by the change in temperature. Factors of a reduction in the detection sensitivity are, for example, other than the coefficient of temperature resistance of the materials of the wires and the via, a great influence of a change in the resistance between the materials of the wires and the via, high variation between parts, and a great change with time.

SUMMARY

An element substrate of the disclosure has a layered structure including a heating resistance element, a first insulation layer where a temperature detection element constituted by a via is formed, and a second insulation layer provided between the heating resistance element and the temperature detection element which electrically insulates the heating resistance element and the temperature detection element.

Further features of the present disclosure will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A to **1**C are a plan view and sectional views schematically illustrating an element substrate.

FIGS. **2**A to **2**G are sectional views schematically illustrating a method of manufacturing the element substrate.

FIGS. **3**A and **3**B are a plan view and a sectional view schematically illustrating the element substrate.

FIGS. **4**A to **4**C are a plan view and sectional views schematically illustrating the element substrate.

FIGS. **5**A and **5**B are a plan view and a sectional view schematically illustrating the element substrate.

FIG. **6** is a plan view schematically illustrating a liquid ejection head.

DESCRIPTION OF THE EMBODIMENTS

Embodiments of the disclosure will be described below with reference to the drawings. Note that, in the following description and the drawings, a plurality of drawings may be cross-referenced with each other. Further, common references are applied to equivalent or similar configurations and description thereof will be appropriately omitted.

First Embodiment

A first embodiment will be described with reference to FIGS. **1**A to **1**C. FIG. **1**A is a schematic plan view illustrating a part of an element substrate **10**. FIG. **1**A illustrates one heating resistance element **112** of a plurality of heating resistance elements **112** provided in the element substrate **10** and a periphery thereof. Note that, to indicate a positional relationship between layers of the element substrate **10**, FIG. **1**A illustrates a portion of the layers in cutaway. Plan views of the element substrate **10** in the following embodiments are also illustrated similarly to in FIG. **1**A. FIG. **1**B is a schematic sectional view of the element substrate **10** taken along IB-IB in FIG. **1**A. FIG. **1**C is a schematic sectional view of the element substrate **10** taken along IC-IC in FIG. **1**A. Moreover, FIG. **6** is a schematic plan view illustrating a liquid ejection head **200** including the element substrate **10**.

The liquid ejection head **200** includes the element substrate **10** provided with a heating resistance element **112**, and an ejection port forming member **601** formed with an ejection port **600** through which liquid is ejected by using heat generated by the heating resistance element **112**. A plurality of ejection port arrays **602** in each of which a plurality of ejection ports **600** are arrayed is disposed in the ejection port forming member **601**. The heating resistance element **112** and a temperature detection element **110** are formed and arranged in the element substrate **10** so as to correspond to the respective ejection ports **600**. An electrode terminal **115** connected to an external wire is provided in a periphery of the element substrate **10**.

Next, a configuration of the element substrate **10** will be described. In the present specification, the element substrate **10** has a layered structure in which a plurality of layers are stacked in a layered manner, and in a sectional view such as FIG. **1**B, the layering direction in the element substrate **10** coincides with the up-down direction in the figure. For convenience, description will be given by assuming that, in the element substrate **10**, a substrate **100** side is a lower side, and a side from which liquid is ejected is an upper side, but the element substrate **10** is not limited to having an up-down orientation.

The element substrate **10** includes the substrate **100** formed of, for example, single-crystal silicon, and an insulation layer **101** is arranged on the substrate **100**. The insulation layer **101** is formed of, for example, an inorganic material made of silicon oxide and has an electrical insulation property to electrically isolate respective wires from each other. The insulation layer **101** is formed by stacking a plurality of insulation layers **101**_a_, **101**_b_, and **101**_c_ in a layered manner. In the present specification, the respective layers are individually referred to in some cases, and the respective layers are collectively referred to as the insulation layer **101** in other cases. On the substrate **100**, for example, connection wires **102**, **104**, and **106** and signal wires **103**, **105**, and **107** are arranged to provide a multilayer wiring structure. Thereby, even in a case of a complex circuit configuration, the degree of integration is able to be enhanced without increasing the chip area. The signal wires **103**, **105**, and **107** are formed of, for example, a metal material having aluminum or copper as a main component. The connection wires **102**, **104**, and **106** are formed of, for example, a metal material having tungsten or copper as a main component.

A power supply wire **108** is arranged in the insulation layer **101**. The power supply wire **108** is patterned and arranged as power supply wires **108**_a_, **108**_b_, **108**_c_, and **108**_d_. The power supply wire **108** is formed of, for example, a metal material having aluminum or copper as a main component.

A connection wire **109** and the temperature detection element **110** are arranged on the power supply wire **108**. The connection wire **109** and the temperature detection element **110** are electrically connected to the power supply wire **108**. The connection wire **109** and the temperature detection element **110** may be made of the same material or may be formed at the same time. The connection wire **109** and the temperature detection element **110** are formed of, for example, a metal material having tungsten, copper, or aluminum as a main component. As described later, the connection wire **109** and the temperature detection element **110** are vias formed in the insulation layer **101**_b_ in the insulation layer **101**. A first via that is the connection wire **109** and a second via that is the temperature detection element **110** are formed at the same position in the layered direction of the respective layers. A connection wire **111** is arranged on the connection wire **109**. The connection wire **111** is formed of, for example, a metal material having aluminum or copper as a main component.

Note that, by the temperature detection element **110** performing temperature detection, an ejection state of liquid is able to be detected. More specifically, in accordance with a change in temperature after ejection that varies depending on whether or not liquid is normally ejected, the change in temperature is detected by using the temperature detection element **110**. In accordance with a result of the detection, the heating resistance element **112**, a recovering unit provided in a printer, or the like is able to be controlled.

An uppermost layer of the insulation layer **101** is flattened. Flattening processing is performed by, for example, CMP (chemical mechanical polishing). The flattening processing may be performed during, after, or both during and after each process of forming the connection wires, the signal wires, the power supply wires, and the temperature detection element.

The heating resistance element **112** is arranged on the uppermost surface of the insulation layer **101**. The heating resistance element **112** is electrically connected to the power supply wires **108**_a_ and **108**_b_ via the connection wire **111** and the connection wire **109** and functions as a resistance element between the power supply wire **108**_a_ and the power supply wire **108**_b_. The heating resistance element **112** is formed of, for example, a resistance material such as tantalum silicon nitride or tungsten silicon nitride.

A protective layer **113** is arranged on the heating resistance element **112**. The protective layer **113** is formed of, for example, an inorganic material containing silicon nitride and has an electrical insulation property. An anti-cavitation layer **114** is arranged on the protective layer **113**. In the anti-cavitation layer **114**, a high-melting point metal, such as tantalum or iridium, which has excellent heat resistance is formed in a single-layer manner or a stacked-layer manner. The anti-cavitation layer **114** is formed with a thickness of, for example, 30 to 250 nm. The protective layer **113** is formed with a thickness of, for example, 50 to 200 nm and insulates the heating resistance element **112** and the anti-cavitation layer **114**.

The signal wires **103**, **105**, and **107** are formed with a thickness of, for example, 100 to 400 nm. The power supply wire **108** including the power supply wires **108**_a_ and **108**_b_ that supply power for driving the heating resistance element **112** is formed with a thickness of, for example, 500 to 2000 nm. The lower limit of thickness of each of the connection wires is decided in accordance with the thickness of the lower wire. That is, since the lower limit of thickness of the insulation layer **101** provided on the respective wires is decided in accordance with the thickness of the wires, the lower limit of thickness of the connection wire passing through the insulation layer **101** is also decided in accordance with the thickness of the lower wire. Accordingly, the connection wires **102**, **104**, and **106** provided on the signal wires **103** and **105** and the like are formed with a thickness of, for example, 100 to 400 nm. Moreover, the connection wire **109** and the temperature detection element **110** that are provided on the power supply wire **108** are formed with a thickness of, for example, 500 to 2000 nm.

The temperature detection element **110** is electrically connected to the power supply wires **108**_c_ and **108**_d_ and functions as a temperature detection sensor between the power supply wire **108**_c_ and the power supply wire **108**_d_. As described above, the element substrate **10** includes a plurality of segments in each of which the temperature detection element **110** is provided below the heating resistance element **112** with the insulation layer **101** (**101**_c_) in between.

For the temperature detection element **110** to detect an ejection state of liquid by using heat generated by the heating resistance element **112**, the heating resistance element **112** and the temperature detection element **110** are preferably provided so as to at least partially overlap each other in plan view of the element substrate **10** (FIG. **1**A). Moreover, by increasing the resistance of the temperature detection element **110** in a region where the temperature detection element **110** overlaps the heating resistance element **112**, the temperature detection sensor is able to have enhanced sensitivity. Therefore, it is preferable that the temperature detection element **110** have a meandering shape arranged so as to be folded multiple times and have increased resistance. Further, as described later, since the present embodiment uses the temperature detection element **110** formed only of the via that is not connected to a conductor such as another wire, a margin for a connection with the wire does not need to be provided, and accordingly the width of the temperature detection element **110** is able to be reduced and the resistance thereof is able to be increased.

FIGS. **2**A to **2**G are schematic sectional views illustrating a method of manufacturing the element substrate **10** illustrated in FIGS. **1**A to **1**C. The method of manufacturing the element substrate **10** will be described below in order of steps with reference to FIGS. **2**A to **2**G.

First, as illustrated in FIG. **2**A, the connection wires **102**, **104**, and **106**, the signal wires **103**, **105**, and **107**, the insulation layer **101***a*, and the power supply wire **108** (**108***a* to **108***d*) are formed on the substrate **100** formed of the single-crystal silicon. For forming the wires and the layer, a CVD (chemical vapor deposition) method, a photolithography method, an etching method, a sputtering method, a plating method, a CMP method, and the like, which are known semiconductor manufacturing techniques, are able to be used. The power supply wire **108** is formed in such a manner that a film of a metal material forming the power supply wire **108** is formed on a surface of the insulation layer **101***a*, a resist pattern is formed thereon by a photolithography method, and the resultant is partially removed by an etching method.

Next, as illustrated in FIG. **2**B, a film of silicon oxide is formed by CVD and a surface thereof is flattened by CMP to form the insulation layer **101***b* (first insulation layer).

Next, as illustrated in FIG. **2**C, a photoresist is patterned, the insulation layer **101***b* is subjected to etching, and a hole **201** is formed. The hole **201** is, to expose a surface of the power supply wire **108** from the insulation layer **101***b*, a through hole that passes through the insulation layer **101***b* or a depression formed on the surface of the insulation layer **101***b*. FIGS. **2**A to **2**C also illustrate steps of preparing the substrate **100** including the insulation layer **101** on which at least the depression or the through hole is formed.

Next, as illustrated in FIG. **2**D, a film of tungsten is formed by CVD so as to fill the hole **201**, and a film **202** is formed. Otherwise, a film of aluminum is formed by CVD so as to fill the hole **201**, and the film **202** is formed. Otherwise, copper is plated so as to fill the hole **201**, and the film **202** is formed. As needed, before filling, a film of a barrier metal or a film of a seed layer may be formed by sputtering.

Next, as illustrated in FIG. **2**E, by performing flattening while removing unnecessary tungsten, aluminum, or copper by CMP, the connection wire **109** and the temperature detection element **110** are formed. In this manner, the temperature detection element **110** is formed only of a wire, that is, a via by which inter-layer wires are connected and which is formed by forming a hole or depression in the insulation layer, filling the hole or depression with a metal material, and flattening the surface while removing the unnecessary metal material on the surface. Note that, the temperature detection element **110** formed as described above is formed so that the surface thereof and the surface of the insulation layer **101***b* are flat surfaces. Similarly to the temperature detection element **110**, the connection wire **109** is also the via formed as described above. Note that, unless particularly described in the present specification, as a similar configuration, a connection wire other than the connection wire **109** is also able to be formed by using a similar manufacturing method to that of the connection wire **109**.

Next, as illustrated in FIG. **2**F, the insulation layer **101***c* (second insulation layer) that covers the surface of the insulation layer **101***b*, which is flattened through the film formation of oxide silicon by CVD, and the temperature detection element **110** is formed. The insulation layer **101***c* has a function of electrically insulating the temperature detection element **110** and the heating resistance element **112** which is formed in a later step. The surface of the insulation layer **101***c* may be flattened by CMP, which is not essential because the surface in the state illustrated in FIG. **2**E is flattened.

Next, to form the connection wire **111** as illustrated in FIG. **2**G, a hole is formed in the insulation layer **101***c*, a film of tungsten is formed by CVD so as to fill the hole, and the resultant is flattened while removing unnecessary tungsten by CMP.

Next, a film of tantalum silicon nitride is formed on the insulation layer **101***c* by sputtering and patterned to form the heating resistance element **112**. Further, a film of nitride silicon is formed by CVD, and the protective layer **113** is formed. Further, a film of tantalum is formed by sputtering and patterned to form the anti-cavitation layer **114**. In this manner, the element substrate **10** illustrated in FIGS. **1**A to **1**C is formed.

As described above, in the present embodiment, the temperature detection element **110** constituted by the via is provided in a structure where the temperature detection element **110** is provided below the heating resistance element **112** with the insulation layer **101** in between. The temperature detection element **110** is formed by filling the depression or the through hole provided in the insulation layer **101** (insulation layer **101***b*) with a metal material and flattening the surfaces thereof. Therefore, after the temperature detection element **110** is formed, the surface thereof (surface on a side of the heating resistance element **112**) has no difference in level and is flat. This makes it possible to reduce thickness T (FIG. **1**B) of the insulation layer **101***c* between the heating resistance element **112** and the temperature detection element **110**. When shortening the distance to a heat acting portion that directly transfers heat generated by the heating resistance element **112** to liquid, the temperature detection element **110** is able to have enhanced detection sensitivity to the temperature of the heat acting portion that is used to detect an ejection state of the liquid. In the present embodiment, a surface (surface opposite to a surface facing the heating resistance element **112**) of the anti-cavitation layer **114** that contacts the liquid functions as the heat acting portion. Thus, when the thickness T of the insulation layer **101***c* is reduced, the distance to the heat acting portion is shortened, and accordingly the sensitivity of the temperature detection element **110** is able to be enhanced. Accordingly, the present embodiment is able to provide the element substrate **10** that enables temperature detection sensitivity of the temperature detection element **110** to be enhanced.

Moreover, in the temperature detection element **110** constituted by the via, a connection portion with a conductor such as another wire or via is not formed in a region where the temperature detection element **110** overlaps at least the heating resistance element **112**. In other words, the temperature detection element **110** is formed as a single via in the region where the temperature detection element **110** overlaps at least the heating resistance element **112**. Thereby, there is no influence of connection resistance between a wire and a via, and a change in the resistance of a constituent material of the temperature detection element **110** caused by a change in temperature is easily detected. That is, the change in the resistance of the temperature detection element **110** is able to be made almost equal to the change in temperature. This makes it possible to provide the element substrate **10** that enables the sensitivity of temperature detection by the temperature detection element **110** to be enhanced.

Second Embodiment

A second embodiment will be described with reference to FIGS. **3**A and **3**B. FIG. **3**A is a schematic plan view illustrating a part of the element substrate **10**. FIG. **3**B is a schematic sectional view of the element substrate **10** taken along IIIB-IIIB in FIG. **3**A. In the second embodiment, an example of a mode in which sensitivity is further enhanced by reducing the thickness of a temperature detection element will be described.

Similarly to the first embodiment, the substrate **100**, the insulation layer **101**, the connection wires **102**, **104**, **106**, and **111**, the signal wires **103**, **105**, and **107**, the power supply wire **108**, the heating resistance element **112**, the protective layer **113**, and the anti-cavitation layer **114** are arranged.

A connection wire **309** is arranged on the power supply wire **108**. The connection wire **309** is electrically connected to the power supply wire **108**. The connection wire **309** is formed of, for example, a metal material having tungsten or copper as a main component. A temperature detection element **310** is arranged on the connection wire **309**. The temperature detection element **310** is electrically connected to the power supply wire **108** via the connection wire **309** that is a via different from a via constituting the temperature detection element **310**. The temperature detection element **310** is formed of, for example, a metal material having tungsten, copper, or aluminum as a main component. The connection wire **309** and the temperature detection element **310** are formed in different steps. Note that, the connection wire **309** and the temperature detection element **310** may be formed by partially using a common step as long as a step in which at least the thickness of each of them is defined is performed separately. Therefore, the thickness of the temperature detection element **310** is able to be set to be thin without depending on the thickness of the power supply wire **108**. Here, since a high current flows through the power supply wire **108** (**108***a*, **108***b*) that supplies power for driving the heating resistance element **112**, the thickness of the power supply wire **108** is thick and, for example, 500 to 2000 nm to achieve low resistance and predetermined current density or less. Further, for reliable coverage of the power supply wire **108**, the insulation layer **101***b* that covers the power supply wire **108** also needs to have sufficient thickness. The temperature detection element **110** of the first embodiment has a thickness corresponding to the thickness of a part on the power supply wire **108** in the insulation layer **101***b*. On the other hand, the temperature detection element **310** of the present embodiment is able to have reduced thickness compared to the thickness of the part positioned on the power supply wire **108** in the insulation layer **101***b*. That is, the thickness of the temperature detection element **310** of the present embodiment is able to be thinner than that of the temperature detection element **110** of the first embodiment. Note that, the temperature detection element **310** is able to be formed by using the manufacturing method described in the first embodiment.

As described above, according to the element substrate **10** of the second embodiment, the thickness of the temperature detection element **310** is able to be reduced and the resistance thereof is able to be further increased, and accordingly the element substrate **10** that enables sensitivity of temperature detection to be further enhanced is able to be provided.

Third Embodiment

A third embodiment will be described with reference to FIGS. **4**A to **4**C. FIG. **4**A is a schematic plan view illustrating a part of the element substrate **10**. FIG. **4**B is a schematic sectional view of the element substrate **10** taken along IVB-IVB in FIG. **4**A. In the third embodiment, an example of the mode in which sensitivity is enhanced by reducing the thickness of a temperature detection element, which is different from that of the second embodiment, will be described.

Similarly to the first embodiment, the substrate **100**, the insulation layer **101**, the connection wires **102** and **104**, the signal wire **103**, the heating resistance element **112**, the protective layer **113**, and the anti-cavitation layer **114** are arranged.

A power supply wire **408** is arranged on the connection wire **104**. Connection wires **404**, **406**, and **411** and signal wires **405** and **407** are arranged on the power supply wire **408**.

A temperature detection element **410** is arranged in a layer between the signal wires **405** and **407**, which is the same layer as the connection wire **406**. The signal wires **405** and **407** are formed to be thinner than the power supply wire **408** that supplies power to the heating resistance element **112**. For example, the signal wires **405** and **407** are formed with a thickness of 100 to 400 nm and the power supply wire **408** is formed with a thickness of 500 to 2000 nm. The lower limit of thickness of each of the connection wires and the temperature detection element **410** that are formed as vias is decided in accordance with the thickness of its lower wire. That is, since each of the connection wires and the temperature detection element **410** is the via formed in the insulation layer **101** covering its lower wire, by reducing the thickness of the lower wire, the thickness of the insulation layer covering the lower wire is able to be reduced and the thickness of the via formed in the insulation layer is also able to be reduced. Thus, by forming the temperature detection element **410** on the signal wire **405** that is thinner than the power supply wire **408**, the thickness of the temperature detection element **410** is able to be reduced. In the present embodiment, when the thickness of the signal wires **405** and **407** is 100 to 400 nm, the thickness of the temperature detection element **410** is able to be 100 to 400 nm. Note that, the thickness of the temperature detection element **410** affects detection sensitivity and is thus preferably thin, but the thickness of the temperature detection element **410** is preferably 100 to 2000 nm and more preferably 100 to 400 nm.

In FIG. **4**B, the temperature detection element **410** is connected to the signal wire **405** to enable the temperature detection element **410** to perform signal processing.

FIG. **4**C is a schematic sectional view of the element substrate **10** taken along IVC-IVC in FIG. **4**A and illustrates a mode different from that in FIG. **4**B. In FIG. **4**C, the temperature detection element **410** is connected to the signal wire **407** provided closer to the heating resistance element **112** than the temperature detection element **410** to enable signal processing to be performed. The temperature detection element **410** in FIGS. **4**B and **4**C is able to be formed by the manufacturing method described in the first embodiment.

Moreover, in the third embodiment, the temperature detection element **410** is formed in the same step as the step of forming the connection wire **406** for electrically connecting the heating resistance element **112** and the power supply wire **408**, and accordingly a dedicated mask for forming the temperature detection element **410** is not necessary. Therefore, the third embodiment is able to reduce the number of steps for one mask compared to that in the first embodiment and reduce the number of steps for two masks compared to that in the second embodiment.

As described above, according to the element substrate **10** of the present embodiment, when the thickness of the temperature detection element **410** is reduced, the resistance thereof is able to be further increased while load in a manufacturing process is suppressed. Accordingly, the element substrate **10** that enables sensitivity of temperature detection to be further enhanced is able to be provided.

Fourth Embodiment

A fourth embodiment will be described with reference to FIGS. **5**A and **5**B. FIG. **5**A is a schematic plan view illustrating a part of the element substrate **10**. FIG. **5**B is a schematic sectional view of the element substrate **10** taken along VB-VB in FIG. **5**A. In the fourth embodiment, an example of a mode in which the number of layers of the wires is minimized will be described.

Similarly to the first embodiment, the substrate **100**, the insulation layer **101**, the protective layer **113**, and the anti-cavitation layer **114** are arranged.

A temperature detection element **510** is arranged in the insulation layer **101**. The temperature detection element **510** is able to be formed by the manufacturing method described in the first embodiment. A heating resistance element **512** is arranged on the insulation layer **101**. A power supply wire **508** (**508***a*, **508***b*) is arranged on the heating resistance element **512**. The heating resistance element **512** and the power supply wire **508** may be replaced in the up-down direction. A connection wire **511** is arranged on the temperature detection element **510**. The temperature detection element **510** is electrically connected to the power supply wire **508** (**508***c*, **508***d*) via the connection wire **511** and a connection wire **513** that is formed in the same layer as the heating resistance element **512** by using the same step and the same material as those of the heating resistance element **512**.

As described above, according to the element substrate **10** of the present embodiment, it is possible to provide the element substrate **10** that enables sensitivity of temperature detection by the temperature detection element **510** to be enhanced while further suppressing the load in a manufacturing process.

While the present disclosure has been described with reference to exemplary embodiments, it is to be understood that the disclosure is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of priority from Japanese Patent Application No. 2019-140191, filed Jul. 30, 2019 and Japanese Patent Application No. 2020-104702, filed Jun. 17, 2020, which are hereby incorporated by reference herein in their entirety.

What is claimed is:

1. An element substrate having a layered structure comprising:

a heating resistance element (**112**);

a first insulation layer (**101**B) where a temperature detection element constituted by a via is formed; and

a second insulation layer (**101***c*) provided between the heating resistance element and the temperature detection element which electrically insulates the heating resistance element and the temperature detection element,

wherein a surface of the temperature detection element on a side of the second insulation layer and a surface of the first insulation layer on a side of the second insulation layer are formed as a same surface.

2. The element substrate according to claim **1**, wherein the heating resistance element and the temperature detection element at least partially overlap each other in plan view of the element substrate.

3. The element substrate according to claim **2**, wherein, in the temperature detection element, a connection portion with a conductor separate from the via is not formed in a region where the temperature detection element overlaps the heating resistance element.

4. The element substrate according to claim **1**, wherein the via is formed in a state where at least a depression provided in the first insulation layer or a through hole passing through the first insulation layer is filled with a metal material.

5. The element substrate according to claim **1**, wherein, in the first insulation layer, the via, which is a first via, and a second via that is electrically connected to the heating resistance element are formed of an identical material at an identical position in a layered direction.

6. The element substrate according to claim **5**, further comprising a first wire and a second wire that are electrically connected to the heating resistance element and provided in a layered manner, wherein

the second via connects the first wire and the second wire by passing through the first insulation layer.

7. The element substrate according to claim **1**, further comprising a wire that is electrically connected to the temperature detection element, and a second via that connects the temperature detection element and the wire and is different from the temperature detection element.

8. The element substrate according to claim **1**, wherein the via is formed of a material having any of tungsten, aluminum, and copper as a main component.

9. The element substrate according to claim **1**, wherein a thickness of the temperature detection element is 100 nm to 2000 nm.

10. A liquid ejection head comprising the element substrate according to claim **1** that ejects liquid by using heat generated by the heating resistance element.

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